Supplementary information to “Country resolved combined emission and socio-economic pathways based on the RCP and SSP scenarios”

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Abstract. This supplementary information contains detailed information on data coverage and additional plots for individual gases and scenarios not covered by the plots in the main manuscript.

2.2	Harmonization of emissions data	9
2.3	Harmonization of GDP data	9
2.4	Results for all RCPs and individual gases . . .	9
2.5	Method comparison for individual gases . . .	90
2.6	Bunkers influence for other example countries	111

5 Contents

1	Data coverage	1
1.1	Historical socioeconomic data	1
1.1.1	Historical GDP data	1
1.1.2	Historical population data	2
1.2	SSP country data	2
1.2.1	IIASA Population	2
1.2.2	OECD GDP	2
1.2.3	IIASA GDP	2
1.2.4	Combined GDP	2
1.2.5	PIK GDP	2
1.3	SSP IAM scenarios	3
1.3.1	AIM/CGE	3
1.3.2	GCAM	3
1.3.3	IMAGE	3
1.3.4	MESSAGE-GLOBIOM	3
1.3.5	ReMIND-MAGPIE	3
1.3.6	WITCH-GLOBIOM	4
1.4	Downscaled data	4
1.4.1	Data requirements for downscaling . . .	4
1.4.2	Country coverage of final timeseries . . .	4
2	Additional figures	9
2.1	RCP and SSPv2 overview	9

1 Data coverage

This section gives an overview over countries covered by historical data (Section 1.1), the SSP basic elements country data (Section 1.2), and the SSPv2 IAM data from the different modeling groups (Section 1.3). The section also explains the data requirements for the downscaling (Section 1.4.1) and the country coverage of the final time series (Section 1.4.2), including a table with all countries and modeling groups (Table 2).

The country definitions of the PRIMAP-hist v2.1 emissions time series (Gütschow et al., 2019) are the basis for the country definitions used in this work. PRIMAP-hist v2.1 covers 208 countries and territories. In the following sections we list differences in country coverage in the present dataset compared with the PRIMAP-hist v2.1 emissions time series.

1.1 Historical socioeconomic data

1.1.1 Historical GDP data

The PRIMAP-hist GDP time series covers 204 countries and territories. However, 7 of these countries and territories are not included as independent countries in the country definitions of the emissions data and are therefore summed with other countries to reach the same country definitions. These

countries and territories are: Bermuda; Curacao; Cayman Is.; Montserrat; Puerto Rico; Palestine; Palestine. One country / territory is made available through summing: Antilles. 10 countries / territories with emissions data are missing in the GDP data: Andorra; Antarctica; Cook Is.; Liechtenstein; Monaco; Niue; Pitcairn Is.; St. Helena; Tokelau; Vatican City.

1.1.2 Historical population data

The PRIMAP-hist population time series covers 233 countries and territories. However, 28 of these countries and territories are not included as independent countries in the country definitions of the emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: American Samoa; Bonaire, Sint Eustatius & Saba; Bermuda; CHANNEL ISLANDS; Curacao; Cayman Is.; West. Sahara; Falkland Is.; Faroe Is.; Gibraltar; Guadeloupe; Greenland; French Guiana; Guam; Isle of Man; Mariana Is.; Montserrat; Martinique; Mayotte; New Caledonia; Puerto Rico; Palestine; French Polynesia; Reunion; St. Pierre & Miquelon; Sint Maarten; U.S. Virgin Is.; U.S. Virgin Is.. One country / territory is made available through summing: Antilles. 2 countries / territories with emissions data are missing in the population data: Antarctica; Pitcairn Is..

1.2 SSP country data

1.2.1 IIASA Population

The SSP IIASA Population time series covers 193 countries and territories. However, 11 of these countries and territories are not included as independent countries in the country definitions of the historical emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: Guadeloupe; French Guiana; Guam; Martinique; Mayotte; New Caledonia; Puerto Rico; Palestine; French Polynesia; Reunion; U.S. Virgin Is.. 26 countries / territories with historical emissions data are missing in the IIASA Population data: Anguilla; Andorra; Antilles; Antarctica; Antigua & Barbuda; Cook Is.; Dominica; Kiribati; St. Kitts & Nevis; Liechtenstein; Monaco; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; St. Helena; San Marino; South Sudan; Seychelles; Turks & Caicos Is.; Tokelau; Tuvalu; Taiwan; Vatican City; Brit. Virgin Is..

1.2.2 OECD GDP

The SSP OECD GDP time series covers 184 countries and territories. However, 4 of these countries and territories are not included as independent countries in the country definitions of the historical emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: New Caledonia;

Puerto Rico; Palestine; French Polynesia. 28 countries / territories with historical emissions data are missing in the OECD GDP data: Anguilla; Andorra; Antilles; Antarctica; Antigua & Barbuda; Cook Is.; Dominica; Micronesia; Grenada; Kiribati; St. Kitts & Nevis; Liechtenstein; Monaco; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; North Korea; St. Helena; San Marino; South Sudan; Seychelles; Turks & Caicos Is.; Tokelau; Tuvalu; Vatican City; Brit. Virgin Is..

1.2.3 IIASA GDP

The SSP IIASA GDP time series covers 172 countries and territories. However, one of these countries and territories is not included as an independent country in the country definitions of the historical emissions data and are therefore summed with another country to reach the same country definitions. This country is: Puerto Rico. 37 countries / territories with historical emissions data are missing in the IIASA GDP data: Aruba; Afghanistan; Angola; Anguilla; Albania; Andorra; Antilles; United Arab Emirates; Antarctica; Antigua & Barbuda; Cook Is.; Dominica; Micronesia; Kiribati; St. Kitts & Nevis; Liechtenstein; Macao; Monaco; Marshall Is.; Myanmar; Montenegro; Niue; Nauru; Pitcairn Is.; Palau; North Korea; Qatar; St. Helena; San Marino; South Sudan; Seychelles; Turks & Caicos Is.; Tokelau; Tuvalu; Taiwan; Vatican City; Brit. Virgin Is..

1.2.4 Combined GDP

The SSP Combined GDP time series covers 186 countries and territories. However, 4 of these countries and territories are not included as independent countries in the country definitions of the historical emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: New Caledonia; Puerto Rico; Palestine; French Polynesia. 26 countries / territories with historical emissions data are missing in the Combined GDP data: Anguilla; Andorra; Antilles; Antarctica; Antigua & Barbuda; Cook Is.; Dominica; Micronesia; Kiribati; St. Kitts & Nevis; Liechtenstein; Monaco; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; North Korea; St. Helena; San Marino; Seychelles; Turks & Caicos Is.; Tokelau; Tuvalu; Vatican City; Brit. Virgin Is..

1.2.5 PIK GDP

PIK GDP data is available on a level of 32 regions. It is down-scaled using the GDP data from OECD. Missing countries are taken from IIASA GDP data where available. Thus, the country availability is governed by the OECD and IIASA GDP data as well as the region definitions. A total of 20 countries / territories present in the historical emissions data are not covered by the region definitions. The SSP PIK GDP time series covers 186 countries and territories. However, 4 of these countries and territories are not included as independent countries in the country definitions of the historical

emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: New Caledonia; Puerto Rico; Palestine; French Polynesia. 26 countries / territories with historical emissions data are missing in the PIK GDP data: Anguilla; Andorra; Antilles; Antarctica; Antigua & Barbuda; Cook Is.; Dominica; Micronesia; Kiribati; St. Kitts & Nevis; Liechtenstein; Monaco; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; North Korea; St. Helena; San Marino; Seychelles; Turks & Caicos Is.; Tokelau; Tuvalu; Vatican City; Brit. Virgin Is..

1.3 SSP IAM scenarios

1.3.1 AIM/CGE

The SSP IAM scenarios from the AIM/CGE model cover 201 countries and territories. However, 17 of these countries and territories are not included as independent countries in the country definitions of the historical emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: French Southern Territories; Bermuda; West. Sahara; Falkland Is.; Faroe Is.; Gibraltar; Guadeloupe; Greenland; French Guiana; Guam; Martinique; Mayotte; New Caledonia; Puerto Rico; French Polynesia; Reunion; U.S. Virgin Is.. 24 countries / territories with historical emissions data are missing in the SSP IAM scenarios from the AIM/CGE model: Anguilla; Andorra; Antarctica; Cook Is.; Dominica; Kiribati; St. Kitts & Nevis; St. Lucia; Macao; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; St. Helena; Sao Tome & Principe; Seychelles; Turks & Caicos Is.; Tokelau; Tonga; Tuvalu; Vatican City; St. Vincent & Grenadines; Brit. Virgin Is..

1.3.2 GCAM

The SSP IAM scenarios from the GCAM model cover 201 countries and territories. However, 16 of these countries and territories are not included as independent countries in the country definitions of the historical emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: Bermuda; West. Sahara; Falkland Is.; Faroe Is.; Gibraltar; Guadeloupe; Greenland; French Guiana; Guam; Martinique; Mayotte; New Caledonia; Puerto Rico; French Polynesia; Reunion; U.S. Virgin Is.. 23 countries / territories with historical emissions data are missing in the SSP IAM scenarios from the GCAM model: Anguilla; Andorra; Antarctica; Cook Is.; Dominica; Kiribati; St. Kitts & Nevis; St. Lucia; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; St. Helena; Sao Tome & Principe; Seychelles; Turks & Caicos Is.; Tokelau; Tonga; Tuvalu; Vatican City; St. Vincent & Grenadines; Brit. Virgin Is..

1.3.3 IMAGE

The SSP IAM scenarios from the IMAGE model cover 203 countries and territories. However, 18 of these countries and territories are not included as independent countries in the country definitions of the historical emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: French Southern Territories; Bermuda; West. Sahara; Falkland Is.; Faroe Is.; Gibraltar; Guadeloupe; Greenland; French Guiana; Guam; Martinique; Mayotte; New Caledonia; Puerto Rico; Palestine; French Polynesia; Reunion; U.S. Virgin Is.. 23 countries / territories with historical emissions data are missing in the SSP IAM scenarios from the IMAGE model: Anguilla; Andorra; Antarctica; Cook Is.; Dominica; Kiribati; St. Kitts & Nevis; St. Lucia; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; St. Helena; Sao Tome & Principe; Seychelles; Turks & Caicos Is.; Tokelau; Tonga; Tuvalu; Vatican City; St. Vincent & Grenadines; Brit. Virgin Is..

1.3.4 MESSAGE-GLOBIOM

The SSP IAM scenarios from the MESSAGE-GLOBIOM model cover 196 countries and territories. However, 14 of these countries and territories are not included as independent countries in the country definitions of the historical emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: French Southern Territories; Bermuda; West. Sahara; Falkland Is.; Faroe Is.; Gibraltar; Guadeloupe; Greenland; Guam; Martinique; New Caledonia; Puerto Rico; French Polynesia; Reunion. 26 countries / territories with historical emissions data are missing in the SSP IAM scenarios from the MESSAGE-GLOBIOM model: Aruba; Anguilla; Andorra; Antarctica; Cook Is.; Dominica; Micronesia; Grenada; Kiribati; St. Kitts & Nevis; St. Lucia; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; St. Helena; Sao Tome & Principe; Seychelles; Turks & Caicos Is.; Tokelau; Tonga; Tuvalu; Vatican City; St. Vincent & Grenadines; Brit. Virgin Is..

1.3.5 ReMIND-MAGPIE

The SSP IAM scenarios from the ReMIND-MAGPIE model cover 184 countries and territories. However, 8 of these countries and territories are not included as independent countries in the country definitions of the historical emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: Bermuda; West. Sahara; Guadeloupe; French Guiana; Martinique; New Caledonia; Puerto Rico; Reunion. 32 countries / territories with historical emissions data are missing in the SSP IAM scenarios from the ReMIND-MAGPIE model: Aruba; Anguilla; Andorra; Antilles; Antarctica; Cook Is.; Dominica; Micronesia; Kiribati; St. Kitts & Nevis; St. Lucia;

Liechtenstein; Macao; Monaco; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; St. Helena; San Marino; Sao Tome & Principe; Seychelles; Turks & Caicos Is.; Tokelau; Tonga; Tuvalu; Vatican City; St. Vincent & Grenadines; Brit. Virgin Is.; Vanuatu; Samoa.

1.3.6 WITCH-GLOBIOM

The SSP IAM scenarios from the WITCH-GLOBIOM model cover 201 countries and territories. However, 16 of these countries and territories are not included as independent countries in the country definitions of the historical emissions data and are therefore summed with other countries to reach the same country definitions. These countries and territories are: Bermuda; West. Sahara; Falkland Is.; Faroe Is.; Gibraltar; Guadeloupe; Greenland; French Guiana; Guam; Martinique; Mayotte; New Caledonia; Puerto Rico; French Polynesia; Reunion; U.S. Virgin Is.. 23 countries / territories with historical emissions data are missing in the SSP IAM scenarios from the WITCH-GLOBIOM model: Anguilla; Andorra; Antarctica; Cook Is.; Dominica; Kiribati; St. Kitts & Nevis; St. Lucia; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; St. Helena; Sao Tome & Principe; Seychelles; Turks & Caicos Is.; Tokelau; Tonga; Tuvalu; Vatican City; St. Vincent & Grenadines; Brit. Virgin Is..

1.4 Downscaled data

1.4.1 Data requirements for downscaling

To downscale the regional SSP IAM socioeconomic data to country level the SSP country level data is used, as it is also the basis of the SSP IAM simulations. Population data is taken from IIASA, GDP data from OECD. We use GDP data from IIASA to fill countries missing in the OECD data. For the downscaling of emissions data we need GDP time series and thus to be present in the downscaled SSP IAM emissions time series of a specific model, a country / territory needs to be both present in the models regional definitions as well as the GDP time series of OECD or IIASA. The following 30 countries / territory are present in (some) regional definitions, but are missing in the country data and are consequently not included in the downscaled emissions data: Anguilla; Andorra; Antilles; Antarctica; Antigua & Barbuda; Cook Is.; Dominica; Micronesia; Kiribati; St. Kitts & Nevis; St. Lucia; Liechtenstein; Monaco; Marshall Is.; Niue; Nauru; Pitcairn Is.; Palau; North Korea; St. Helena; San Marino; Sao Tome & Principe; Seychelles; Turks & Caicos Is.; Tokelau; Tonga; Tuvalu; Vatican City; St. Vincent & Grenadines; Brit. Virgin Is..

Most of the present countries are taken from OECD data with some exceptions. The following 10 countries / territories are taken from IIASA GDP data: Aruba; Afghanistan; Angola; Albania; United Arab Emirates; Macao; Myanmar;

Montenegro; Qatar; Taiwan. One country / territory is added using downscaling: South Sudan.

1.4.2 Country coverage of final timeseries

The time series presented in this paper cover a total of 182 countries which represent 99.8 percent of the world's fossil fuel and industrial greenhouse gas emissions (2011 - 2017 average). Table 1 gives detailed per regions and gas coverage numbers.

Some countries / territories are not present in the time series from all modeling groups. Table 2 gives an overview over the inclusion of countries / territories in the final time series and the individual models.

Gas	Global	Asia	Latin America America	Middle East and Africa	OECD	Reforming Economies
Kyoto Gases (AR4)	99.8%	99.7%	99.9%	100.0%	100.0%	100.0%
CO ₂	99.8%	99.8%	99.9%	100.0%	100.0%	100.0%
CH ₄	99.8%	99.6%	100.0%	100.0%	100.0%	100.0%
N ₂ O	99.9%	99.9%	100.0%	100.0%	100.0%	100.0%
F-gases (AR4)	99.3%	98.9%	100.0%	100.0%	100.0%	100.0%

Table 1. Emissions shares covered by the dataset for each region and gas. Shares are calculated using the (2011 – 2017) average.

[illegible]

[illegible]

Country ISO3	Historical GDP	Historical Population	This work	SSP IIASA Pop.	SSP IIASA GDP	SSP OECD GDP	SSP comb. GDP	SSP PIK GDP	SSPIAM AIM/CGE	SSPIAM GCAM	SSPIAM WITCH- GLOBIOM	SSPIAM ReMIND- MAGPIE	SSPIAM MESSAGE- GLOBIOM	SSPIAM IMAGE
UKR	1	1	9	1	1	1	1	1	1	1	1	1	1	1
URY	1	1	9	1	1	1	1	1	1	1	1	1	1	1
USA	1	1	9	1	1	1	1	1	1	1	1	1	1	1
UZB	1	1	9	1	1	1	1	1	1	1	1	1	1	1
VAT	0	1	0	0	0	0	0	0	0	0	0	0	0	0
VCT	1	1	4	1	1	1	1	1	0	0	0	0	0	0
VEN	1	1	9	1	1	1	1	1	1	1	1	1	1	1
VGB	1	1	0	0	0	0	0	0	0	0	0	0	0	0
VNM	1	1	9	1	1	1	1	1	1	1	1	1	1	1
VUT	1	1	8	1	1	1	1	1	1	1	1	1	0	1
WSM	1	1	8	1	1	1	1	1	1	1	1	1	0	1
YEM	1	1	9	1	1	1	1	1	1	1	1	1	1	1
ZAF	1	1	9	1	1	1	1	1	1	1	1	1	1	1
ZMB	1	1	9	1	1	1	1	1	1	1	1	1	1	1
ZWE	1	1	9	1	1	1	1	1	1	1	1	1	1	1

Table 2: Availability of data for individual countries / territories in data from the different models. The number in the column "This work" indicates the number of models where data are available. Final data for SSP IAM runs are only available if a country / territory is both present in the region definitions of the model and in the country resolved SSP data of at least one modeling group.

2 Additional figures

2.1 RCP and SSPv2 overview

This section contains the RCP and SSPv2 scenario overview figures for individual gases. A figure for aggregate Kyoto
5 GHGs is presented in the main text (Figure 3).

2.2 Harmonization of emissions data

This section contains figures illustrating the effect of harmonization for individual gases. Figure 5 shows scenario harmonization for CO₂, Figure 6 for N₂O, Figure 7 for CH₄,
10 and Figure 8 for fluorinated gases. Harmonization factors are similar for all RCP forcing levels as the IAM groups use the same historical data for all their scenarios. Thus only one RCP is used in the figures. The discrepancies between the historical emissions in some of the downscaled scenarios and
15 PRIMAP-hist emissions are due to model region definitions that do not cover all countries covered by PRIMAP-hist.

2.3 Harmonization of GDP data

Here we show the effect of harmonization on regional GDP time series. The harmonization is the same for all SSPs and
20 thus we present only SSP 3 (Figure 9) where the effects is best visible because of the lowest GDP growth of all SSPs.

2.4 Results for all RCPs and individual gases

In this section we present the downscaling results for all RCP and SSPs including individual gases for the example countries. Results for other countries can be provided. Figures 10
25 to 19 provide the data for RCP 1.9.

Figures 20 to 29 provide the data for RCP 2.6.

Figures 30 to 39 provide the data for RCP 3.4.

Figures 40 to 49 provide the data for RCP 4.5.

Figure 1. RCP and SSPv2 scenarios for total CO₂ emissions excluding LULUCF. Scenarios are not harmonized to historical data. Historical data shown is from PRIMAP-hist v2.1 with bunker fuel CO₂ emissions added from CDIAC data (Boden et al., 2017).

Figure 3. RCP and SSPv2 scenarios for total CH₄ emissions excluding LULUCF. Scenarios are not harmonized to historical data. Historical data shown is from PRIMAP-hist v2.1.

RCP and SSPv2 scenarios for total Fluorinated gases (AR4) excl. LULUCF

Figure 4. RCP and SSPv2 scenarios for total fluorinated gases emissions excluding LULUCF. Scenarios are not harmonized to historical data. Historical data shown is from PRIMAP-hist v2.1.

Figure 5. Harmonization of scenarios to historical data for CO₂ and RCP 4.5. The harmonization factor is phased out until 2050. The regions shown here are built from downscaled data to harmonize the region definitions of the SSPv2 scenarios to the RCP regions.

Figure 6. Harmonization of scenarios to historical data for N₂O and RCP 4.5. The harmonization factor is phased out until 2050. The regions shown here are built from downscaled data to harmonize the region definitions of the SSPv2 scenarios to the RCP regions.

Figure 7. Harmonization of scenarios to historical data for CH_4 and RCP 4.5. The harmonization factor is phased out until 2050. The regions shown here are built from downscaled data to harmonize the region definitions of the SSPv2 scenarios to the RCP regions.

Harmonization for total Fluorinated gases (AR4) excl. LULUCF (RCP 4.5)

Figure 8. Harmonization of scenarios to historical data for fluorinated gases and RCP 4.5. The harmonization factor is phased out until 2050. The regions shown here are built from downscaled data to harmonize the region definitions of the SSPv2 scenarios to the RCP regions.

Figure 9. Harmonization of scenarios to historical data for GDP and SSP 3. The regions shown here are built from downscaled data to harmonize the region definitions of the SSPv2 scenarios to the RCP regions.

Figure 10. Kyoto GHG (AR4) results for 1.9 W/m^2 and all SSPs for SSP IAM scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 11. Kyoto GHG (AR4) results for 1.9 W/m^2 and all SSPs for SSP IAM scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 13. CO₂ results for 1.9 W/m^2 and all SSPs for SSP IAM scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 14. CH₄ results for 1.9 W/m^2 and all SSPs for SSP IAM scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 15. CH₄ results for 1.9 W/m^2 and all SSPs for SSP IAM scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 16. N₂O results for 1.9W/m² and all SSPs for SSP IAM scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 17. N₂O results for 1.9W/m² and all SSPs for SSP IAM scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 18. Fluorinated gases (AR4) results for $1.9W/m^2$ and all SSPs for SSP IAM scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 19. Fluorinated gases (AR4) results for 1.9W/m² and all SSPs for SSP IAM scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 21. Kyoto GHG (AR4) results for RCP 2.6 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 22. CO₂ results for RCP 2.6 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 23. CO₂ results for RCP 2.6 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 25. CH₄ results for RCP 2.6 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 26. N₂O results for RCP 2.6 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 27. N_2O results for RCP 2.6 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 28. Fluorinated gases (AR4) results for RCP 2.6 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 29. Fluorinated gases (AR4) results for RCP 2.6 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 30. Kyoto GHG (AR4) results for 3.4 W/m^2 and all SSPs for SSPv2d scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 31. Kyoto GHG (AR4) results for 3.4 W/m^2 and all SSPs for SSPv2d scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 33. CO₂ results for 3.4 W/m^2 and all SSPs for SSPv2d scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 34. CH₄ results for 3.4W/m² and all SSPs for SSPv2d scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 35. CH₄ results for 3.4 W/m^2 and all SSPs for SSPv2d scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 36. N₂O results for 3.4W/m² and all SSPs for SSPv2d scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 37. N₂O results for 3.4W/m² and all SSPs for SSPv2d scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 38. Fluorinated gases (AR4) results for $3.4W/m^2$ and all SSPs for SSPv2d scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 39. Fluorinated gases (AR4) results for 3.4 W/m^2 and all SSPs for SSPv2d scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 40. Kyoto GHG (AR4) results for RCP 4.5 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 41. Kyoto GHG (AR4) results for RCP 4.5 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 43. CO₂ results for RCP 4.5 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 44. CH₄ results for RCP 4.5 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 45. CH₄ results for RCP 4.5 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 46. N₂O results for RCP 4.5 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 47. N₂O results for RCP 4.5 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 48. Fluorinated gases (AR4) results for RCP 4.5 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 49. Fluorinated gases (AR4) results for RCP 4.5 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figures 50 to 59 provide the data for RCP 6.0.

Figures 60 to 69 provide the data for baseline scenarios.

Figures 70 to 79 provide the data for RCP 8.5.

Figure 50. Kyoto GHG (AR4) results for RCP 6.0 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 51. Kyoto GHG (AR4) results for RCP 6.0 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 53. CO₂ results for RCP 6.0 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 54. CH₄ results for RCP 6.0 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 55. CH₄ results for RCP 6.0 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 56. N₂O results for RCP 6.0 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 57. N₂O results for RCP 6.0 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 58. Fluorinated gases (AR4) results for RCP 6.0 and all SSPs for both SSPv2d and RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 59. Fluorinated gases (AR4) results for RCP 6.0 and all SSPs for both SSPv2d and RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 60. Kyoto GHG (AR4) results for SSPv2d baseline scenarios for all SSPs. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 61. Kyoto GHG (AR4) results for SSPv2d baseline scenarios for all SSPs. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 62. CO₂ results for SSPv2d baseline scenarios for all SSPs. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 63. CO₂ results for SSPv2d baseline scenarios for all SSPs. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 64. CH₄ results for SSPv2d baseline scenarios for all SSPs. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 65. CH₄ results for SSPv2d baseline scenarios for all SSPs. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 66. N₂O results for SSPv2d baseline scenarios for all SSPs. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 67. N₂O results for SSPv2d baseline scenarios for all SSPs. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 68. Fluorinated gases (AR4) results for SSPv2d baseline scenarios for all SSPs. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 69. Fluorinated gases (AR4) results for SSPv2d baseline scenarios for all SSPs. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 70. Kyoto GHG (AR4) results for RCP 8.5 and all SSPs for RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 71. Kyoto GHG (AR4) results for RCP 8.5 and all SSPs for RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 72. CO₂ results for RCP 8.5 and all SSPs for RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 73. CO₂ results for RCP 8.5 and all SSPs for RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 74. CH₄ results for RCP 8.5 and all SSPs for RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 75. CH₄ results for RCP 8.5 and all SSPs for RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 76. N₂O results for RCP 8.5 and all SSPs for RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 77. N₂O results for RCP 8.5 and all SSPs for RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

Figure 78. Fluorinated gases (AR4) results for RCP 8.5 and all SSPs for RCPd scenarios. Countries from OECD and Asia regions. Note: Korea is in the OECD region for the WITCH GLOBIOM model.

Figure 79. Fluorinated gases (AR4) results for RCP 8.5 and all SSPs for RCPd scenarios. Countries from Latin America, Reforming Economies and Middle East and Africa regions.

2.5 Method comparison for individual gases

In this section we present individual gas figures for the comparison of downscaling methods for RCP 2.6, SSP 2 (also used in the main manuscript, Figures 80 to 89) and an additional high emissions - high growth scenario RCP 6.0, SSP 5 (Figures 90 to 99). Results for other RCP SSP combinations and countries can be provided.

Figure 80. Influence of the downscaling method on country Kyoto GHG (AR4) emissions for RCP 2.6, SSP 2. Ranges are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 82. Influence of the downscaling method on country CO₂ emissions for RCP 2.6, SSP 2. Ranges are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 83. Influence of the downscaling method on country CO₂ emissions for RCP 2.6, SSP 2. Ranges and median are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 84. Influence of the downscaling method on country CH₄ emissions for RCP 2.6, SSP 2. Ranges are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 85. Influence of the downscaling method on country CH₄ emissions for RCP 2.6, SSP 2. Ranges and median are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 86. Influence of the downscaling method on country N₂O emissions for RCP 2.6, SSP 2. Ranges are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 87. Influence of the downscaling method on country N₂O emissions for RCP 2.6, SSP 2. Ranges and median are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 88. Influence of the downscaling method on country fluorinated gases (AR4) emissions for RCP 2.6, SSP 2. Ranges are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 89. Influence of the downscaling method on country fluorinated gases (AR4) emissions for RCP 2.6, SSP 2. Ranges and median are calculated over all SSP IAM implementations. RCP SSP scenarios are shown as individual lines only (dashed).

Figure 90. Influence of the downscaling method on country Kyoto GHG (AR4) emissions for RCP 6.0, SSP 5. Ranges are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 91. Influence of the downscaling method on country Kyoto GHG (AR4) emissions for RCP 6.0, SSP 5. Ranges and median are calculated over all SSP IAM implementations. RCP SSP scenarios are shown as individual lines only (dashed).

Figure 92. Influence of the downscaling method on country CO₂ emissions for RCP 6.0, SSP 5. Ranges are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 93. Influence of the downscaling method on country CO₂ emissions for RCP 6.0, SSP 5. Ranges and median are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 94. Influence of the downscaling method on country CH₄ emissions for RCP 6.0, SSP 5. Ranges are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 95. Influence of the downscaling method on country CH₄ emissions for RCP 6.0, SSP 5. Ranges and median are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 96. Influence of the downscaling method on country N₂O emissions for RCP 6.0, SSP 5. Ranges are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 97. Influence of the downscaling method on country N_2O emissions for RCP 6.0, SSP 5. Ranges and median are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 98. Influence of the downscaling method on country fluorinated gases (AR4) emissions for RCP 6.0, SSP 5. Ranges are calculated over all SSPv2d scenarios. RCPd scenarios are shown as individual lines only (dashed).

Figure 99. Influence of the downscaling method on country fluorinated gases (AR4) emissions for RCP 6.0, SSP 5. Ranges and median are calculated over all SSP IAM implementations. RCP SSP scenarios are shown as individual lines only (dashed).

2.6 Bunkers influence for other example countries

In this section we provide figures illustration the influence of removal of bunkers emissions from the scenarios for the example countries not covered in the main manuscript. Results are shown in Figures 100 to 110. Results for other countries and individual gases can be provided.

Figure 101. Influence of bunkers emissions on results for Bulgaria. Ranges and median are calculated over all SSPs and all SSPv2d scenarios for each RCP. RCPd scenarios are shown as individual lines only (dashed).

Figure 102. Influence of bunkers emissions on results for Brazil. Ranges and median are calculated over all SSPs and all SSPv2d scenarios for each RCP. RCPd scenarios are shown as individual lines only (dashed).

Figure 103. Influence of bunkers emissions on results for China. Ranges and median are calculated over all SSPs and all SSPv2d scenarios for each RCP. RCPd scenarios are shown as individual lines only (dashed).

Figure 104. Influence of bunkers emissions on results for Great Britain. Ranges and median are calculated over all SSPs and all SSPv2d scenarios for each RCP. RCPd scenarios are shown as individual lines only (dashed).

Figure 105. Influence of bunkers emissions on results for Guatemala. Ranges and median are calculated over all SSPs and all SSPv2d scenarios for each RCP. RCPd scenarios are shown as individual lines only (dashed).

Figure 106. Influence of bunkers emissions on results for Korea. Ranges and median are calculated over all SSPs and all SSPv2d scenarios for each RCP. RCPd scenarios are shown as individual lines only (dashed).

Figure 107. Influence of bunkers emissions on results for Russia. Ranges and median are calculated over all SSPs and all SSPv2d scenarios for each RCP. RCPd scenarios are shown as individual lines only (dashed).

Figure 109. Influence of bunkers emissions on results for Uzbekistan. Ranges and median are calculated over all SSPs and all SSPv2d scenarios for each RCP. RCPd scenarios are shown as individual lines only (dashed).

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